

Determination of the Limiting Magnitude

Aaron Kingery⁽¹⁾ and Rhiannon Blaauw⁽²⁾*(1)ERC, Inc./Jacobs ESSSA Contract, NASA Meteoroid Environment Office, Marshall Space Flight Center, Huntsville, AL United States, Email: aaron.m.kingery@nasa.gov*

(2) All Points Logistics/Jacobs ESSSA Contract, NASA Meteoroid Environment Office, Marshall Space Flight Center, Huntsville, AL United States, Email: rhiannon.c.blaauwt@nasa.gov

7th European Conference on Space Debris
Darmstadt, Germany
April 2017

Abstract

The limiting magnitude of an optical camera system is an important property to understand since it is used to find the completeness limit of observations. Limiting magnitude depends on the hardware and software of the system, current weather conditions, and the angular speed of the objects observed. If an object exhibits a substantial angular rate during the exposure, its light spreads out over more pixels than the stationary stars. This spreading causes the limiting magnitude to be brighter when compared to the stellar limiting magnitude. The effect, which begins to become important when the object moves a full width at half max during a single exposure or video frame. For targets with high angular speeds or camera systems with narrow field of view or long exposures, this correction can be significant, up to several magnitudes.

The stars in an image are often used to measure the limiting magnitude since they are stationary, have known brightness, and are present in large numbers, making the determination of the limiting magnitude fairly simple. In order to transform stellar limiting magnitude to object limiting magnitude, a correction must be applied accounting for the angular velocity. This technique is adopted in meteor and other fast-moving object observations, as the lack of a statistically significant sample of targets makes it virtually impossible to determine the limiting magnitude before the weather conditions change. While the weather is the dominant factor in observing satellites, the limiting magnitude for meteors also changes throughout the night due to the motion of a meteor shower or sporadic source radiant across the sky. This paper presents methods for determining the limiting stellar magnitude and the conversion to the target limiting magnitude.